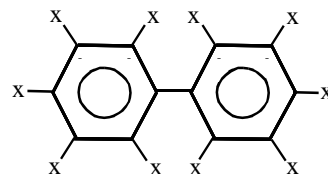


POLYCHLORINATED BIPHENYLS

Polychlorinated biphenyls are federal hazardous air pollutants and were identified as toxic air contaminants in April 1993 under AB 2728.

CAS Registry Number: 1336-36-3

Molecular Formula: One of several aromatic compounds containing two benzene nuclei with two or more substituted chlorine atoms.



x = H or Cl

There are 209 possible polychlorinated biphenyl (PCBs) isomers. PCBs vary in appearance from mobile, oily liquids to white, crystalline solids to hard, non-crystalline resins. They are thermally stable, resistant to oxidation, acids, bases, and other chemical agents, and have excellent dielectric properties. PCBs are colorless crystals in the pure form. The melting point is depressed when PCBs are mixed. PCBs are practically insoluble in water, and soluble in oils and organic solvents. When heated to decomposition, they emit toxic fumes of hydrochloric acid and other chlorinated compounds (NTP, 1991).

Physical Properties of Polychlorinated Biphenyls

Synonyms: PCBs; chlorinated biphenyls; chlorobiphenyls; Aroclor; Clophen; Fenclor; Kanechlor; Phenoclor; Pyralene; Santotherm

Molecular Weight:	291.98 - 360.86
Boiling Point:	340 - 375 °C
Flash Point:	195° C (383 °F) (open cup)
Density/Specific Gravity:	1.4 - 1.5 at 30 °C (water = 1)
Conversion Factor for Aroclor 1260:	1 ppm = 15.4 mg/m ³

(HSDB, 1991; Merck, 1983; Sax, 1987; Sax, 1989; U.S. EPA, 1994a)

SOURCES AND EMISSIONS

A. Sources

Since 1974, all uses of PCBs in the United States have been confined to closed systems such as electrical capacitors, electrical transformers, vacuum pumps, and gas-transmission turbines. PCBs are no longer produced in the United States except for limited research and development applications (NTP, 1991). Sources of PCBs are landfills containing PCB waste materials and products, destruction of manufactured articles containing PCBs in municipal and industrial waste disposal burners, and gradual wear and weathering of PCB-containing products (HSDB, 1991).

Other sources in California that have reported emissions of PCBs are adhesives and sealants, fabricated rubber products, commercial prints and lithographs, and ground or treated mineral facilities, electric services, and refuse systems. The primary stationary sources that have reported emissions of PCBs in California are crude oil pipelines, wholesale trade in miscellaneous durable goods, and hydraulic cement manufacturers (ARB, 1997b).

B. Emissions

The total emissions of PCBs from stationary sources in California are estimated to be at least 15 pounds per year, based on data reported under the Air Toxics “Hot Spots” Program (AB 2588) (ARB, 1997b).

C. Natural Occurrence

PCBs are not known to occur in nature (HSDB, 1991).

AMBIENT CONCENTRATIONS

No Air Resources Board data exist for ambient measurements of PCBs. However, the United States Environmental Protection Agency (U.S. EPA) has compiled data from the Great Lakes region (up to 1991), South Carolina (1976-79), Wisconsin (1977), Minnesota (1978-79), and Colorado (1980). The mean concentrations ranged from 1 to 7.7 nanograms per cubic meter (ng/m³) (U.S. EPA, 1993a).

INDOOR SOURCES AND CONCENTRATIONS

Inside a school, investigators measured an average PCB concentration of 11 ng/m³. Inside the school, an office building, and two homes for the elderly, investigators reported measurable concentrations of PCBs (above median quantifiable limits for each building of 1.0 to 1.2 ng/m³) in about 14 to 73 percent of study samples. However, investigators urged caution in interpreting this data because of the small sample sizes in the study and because of quality control problems during sample collection (Sheldon et al., 1988a).

ATMOSPHERIC PERSISTENCE

PCBs are mixtures of different congeners of chlorobiphenyl, and the relative importance of the environmental fate mechanisms generally depends on the degree of chlorination. In general, the persistence of PCBs increases with an increase in the degree of chlorination.

If released into the atmosphere, PCBs will primarily exist in the vapor phase; the tendency to become associated with the particulate phase will increase as the degree of chlorination of the PCB increases. It is expected that the dominant atmospheric loss process for PCBs is by gas-phase reaction with the hydroxyl (OH) radical (Kwok et al., 1995a). From extrapolation of

experimental data for the monochlorobiphenyls and three of the dichlorobiphenyls, (Kwok et al., 1995a) estimated the lifetimes and half-lives of PCBs. The estimated atmospheric half-lives and lifetimes of PCBs due to reaction with the OH radical are 1.9 to 3.5 days and 2.7 to 5.1 days, respectively, for the monochlorobiphenyls, increasing to about 30 to 90 days and 20 to 60 days, respectively, for the hexachlorobiphenyls (Kwok et al., 1995b).

AB 2588 RISK ASSESSMENT INFORMATION

The Office of Environmental Health Hazard Assessment reviews risk assessments submitted under the Air Toxics “Hot Spots” Program (AB 2588). Of the risk assessments reviewed as of April 1996, PCBs contributed to the total cancer risk in 8 of the approximately 550 risk assessments reporting a total cancer risk equal to or greater than 1 in 1 million. PCBs also contributed to the total cancer risk in 1 of the approximately 130 risk assessments reporting a total cancer risk equal to or greater than 10 in 1 million (OEHHA, 1996a).

For non-cancer health effects, PCBs contributed to a total hazard index greater than 1 in 1 of the approximately 89 risk assessments reporting a total chronic hazard index greater than 1 (OEHHA, 1996b).

HEALTH EFFECTS

Probable routes of human exposure to PCBs are inhalation, ingestion, and dermal contact (NTP, 1994).

Non-Cancer: Exposure to PCBs may cause skin, eyes, nose, throat, and respiratory tract irritation. Chronically overexposed workers may suffer from chloracne and mild liver injury. Infrequently reported symptoms include anorexia, gastrointestinal upset, and peripheral neuropathies (Sittig, 1991). In animal studies, oral exposure to PCBs was reported to cause possible liver, kidney, and central nervous system effects (U.S. EPA, 1994a).

A chronic non-cancer Reference Exposure Level (REL) of 1.2 micrograms per cubic meter is listed for PCBs in the California Air Pollution Control Officers Association Air Toxics “Hot Spots” Program, Revised 1992 Risk Assessment Guidelines. The toxicological endpoints considered for chronic toxicity are the immune system, gastrointestinal system, liver, and reproductive system including teratogenic and developmental effects (CAPCOA, 1993). The U.S. EPA has not established a Reference Concentration (RfC) or an oral Reference Dose (RfD) for PCB mixtures. The RfD for one specific PCB mixture (Aroclor 1016) is 7×10^{-5} milligrams per kilogram per day based on reduced birth weights in monkeys. The U.S. EPA estimates that consumption of this dose or less, over a lifetime, would not likely result in the occurrence of chronic non-cancer effects. The U.S. EPA has not established an RfC for Aroclor 1016 (U.S. EPA, 1994a).

Mothers exposed to PCBs through fish consumption have given birth to infants with adverse developmental effects including motor deficits, impaired psychomotor index, impaired visual

recognition memory, and deficits in short-term memory. Decreased birth weights and lower gestational age at birth are reported among women occupationally exposed to high levels of PCBs as compared to lower levels of PCBs. Animal studies have reported learning deficits, impaired immune function, cellular alterations of the thyroid, and reproductive effects such as decreased fertility, decreased conception, and disrupted ovarian cyclicity (U.S. EPA, 1994a). The State of California has determined under Proposition 65 that PCBs are developmental toxicants (CCR, 1996).

Cancer: Human studies were inconclusive but suggest an association between exposure to PCBs and liver cancer. In studies in which rats and mice were orally exposed to some PCB formulations, an increased incidence of liver tumors was observed (U.S. EPA, 1994a).

The U.S. EPA has classified PCBs as Group B2: Probable human carcinogen. The U.S. EPA has established an ingestion unit risk estimate of 2.2×10^{-4} (microgram per liter)⁻¹. The U.S. EPA estimates that if a person were to ingest water containing PCBs at 0.005 micrograms per liter over an entire lifetime, that person would theoretically have no more than a 1 in 1 million increased chance of developing cancer (U.S. EPA, 1994a). The International Agency for Research on Cancer has classified PCBs as Group 2A: Probable human carcinogen (IARC, 1987a).

The State of California has determined under Proposition 65 that PCBs are carcinogens (CCR, 1996). The inhalation potency factor that has been used as a basis for regulatory action in California is 2.2×10^{-3} (microgram per cubic meter)⁻¹ (OEHHA, 1994). In other words, the potential excess cancer risk for a person exposed over a lifetime to 1 microgram per cubic meter of PCBs is estimated to be no greater than 2,200 in 1 million. The oral potency factor that has been used as a basis for regulatory action in California is 7.7 (milligram per kilogram per day)⁻¹ (OEHHA, 1994).